

# **Anderson 1982 Acquisition of cognitive skill**

## **Research Question:**

Proof that the ACT theory models acquisition of cognitive skills.

## **Approach**

- Behavioral observation of learning tasks.
- There are many effects of learning (E.g. Speed up) the ACT theory is tested against these effects.

## **Findings**

## **Limitations**

- This paper largely discusses only the ACT theory of skill acquisition: knowledge starts as declarative and is then compiled into productions as skill is developed.

## **summary and how does it connect**

- Domain general systems use domain specific information or declarative facts to solve problems.

- In the initial stages of learning a skill, most of the information is declarative and needs active maintenance in WM to be used and proceduralized. In the course of learning, remedial information can be provided to help learning as more declarative information.
  - \* **Mechanisms of compilation:** Initially, information has to be recalled from declarative memory (LTM) and rehearsed in WM to be used. But there is a speed up and efficiency in performance of skill when “information and procedures are compiled”.
- collapsing sequences of productions or procedures into one.- **Composition**
  - \* Procedures or productions are built from earlier procedures in a way that recall and rehearsal into wm is not required. For example, a long list of procedures that defined each individual step involved in typing out a telephone number to call someone is reduced into one procedure that just instructs to “dial number”.
  - \* **Proceduralization** Further example of proceduralized knowledge from Anderson is when dialing a number becomes a proceduralized pattern of motor actions and does not need declarative recall of the phone number.
- Mechanisms of compilation explain speed up, decrease in decision time and diminishing effects of memory set size, where, in a stable environment, with practice the number of items are not as difficult to maintain in memory as they were at the beginning of learning.
- Problem solving is the basic model of cognition. (Newell, 1980).
- Declarative knowledge has to be interpreted to affect behavior. Already existing procedures interpret the new declarative information. Through the above stated mechanisms of compilation, composition and proceduralization, declarative knowledge (facts) is converted in to procedural knowledge (productions).
- **Procedural Learning:** *Tuning* is the process of making search of a problem space more efficient with additional practice or experience which leads to success faster compared to a novice where trial and error search takes time and is less efficient.
- It is very difficult to determine the neural networks involved in this 3-stage version of learning.
  - \* PFC-BG connections that are built out, with the BG learning the simple associations quickly that are collected and organized by the PFC to form

more general skill “knowledge” or organization of simpler skill behaviors/ actions hierarchically. For example, Writing out a function in python is a higher level, mostly PFC guided behavior that is made up of numerous and much simpler behaviors like typing, function knowledge, outcome evaluation, variable assignment, order of operations etc.

- Declarative information can be held in WM to guide behavior. Declarative information provided details for visual, tactile, or auditory signals to keep track of, test hypotheses and plan relevant behaviors or responses with clear definitions of the goal or expected outcomes. Perhaps, in the course of many such behaviors, with each simple stimulus-response being mapped by the BG, the PFC then organizes these behaviors. With practice, the declarative information becomes less useful as maps sustained by BG-PFC connections become more autonomous.

## Highlights

Yellow - points to note/important

Red - questions/discrepancies/disagree/don't understand

Green - connects well with other recognized